

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Reissue Application/Reexamination of: URANO et al.

U.S. Patent No.: 5,216,135

Group Art Unit: 1626

Reexamination No.: 90/004,812

Examiner: STOCKTON, LAURA LYNNE

Filed: October 23, 1997

P.T.O. Confirmation No.: 8528

For: DIAZODISULFONES

**MERGED REISSUE & REEXAMINATION PROCEEDING**  
**CERTIFICATE OF SERVICE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Date: December 14, 2004

Sir:

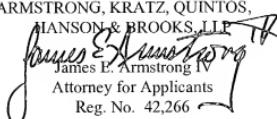
Applicants submit that a copy of the Amendment, Declaration and the Petition for Extension of Time filed with the U.S. Patent and Trademark Office today on December 14, 2004, in the above captioned matter, was served by U.S. Mail, postage pre-paid, on the Requestor in the matter at the following address:

JUDITH A. EVANS  
JONES & VOLENTINE  
12200 Sunrise Valley Drive - Suite 150  
Reston, Virginia 20191

Respectfully submitted,

ARMSTRONG, KRATZ, QUINTOS,

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Atty. Docket No. 910094RE  
Suite 1000, 1725 K Street, N.W.  
Washington, D.C. 20006  
(202) 659-2930



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PATENT TRADEMARK OFFICE

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re the Application of: **URANO et al**

Group Art Unit: **1626**

Serial No.: **90/004,812**

Examiner: **STOCKTON, Laura Lynne**

Filed: **October 23, 1997**

**P.T.O. Confirmation No.: 8528**

For. **DIAZODISULFONES**

**PETITION FOR EXTENSION OF TIME**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Date: December 14, 2004

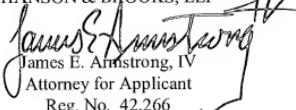
Sir:

Applicants petition the Commissioner for Patents to extend the time for response to the Office Action dated September 14, 2004 for one month, from November 14, 2004 to December 14, 2004.

Attached please find a check in the amount of \$120 to cover the cost of the extension of time. In the event that any additional fees are due in connection with this paper, please charge our Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, KRATZ, QUINTOS,  
HANSON & BROOKS, LLP

  
James E. Armstrong, IV  
Attorney for Applicant  
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In re the Reissue Application/Reexamination of: **URANO et al.**

US Patent No.: **5,216,135**

Group Art Unit: **1626**

Reexam No.: **90/004,812**

Examiner: **STOCKTON, LAURA LYNNE**

Filed: **October 23, 1997**

P.T.O. Confirmation No.: **8528**

For: **DIAZODISULFONES**

**MERGED REISSUE & REEXAMINATION PROCEEDING**  
**AMENDMENT**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

December 14, 2004

Sir:

In response to the Office Action dated **September 14, 2004**, with the period of time being extended by one month, and with the **Declaration filed herewith**, please amend the above-identified application as follows:

**AMENDMENTS TO THE CLAIMS:**

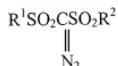
Please cancel claims 1-6 and claims 15-27 without prejudice.

This listing of claims will replace all prior versions, and listings, of claims in the application.

**Listing of Claims:**

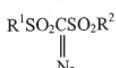
**Claims 1-6 (Canceled).**

**Claim 7 (Previously Presented):** A diazodisulfone compound of the formula:



wherein R<sup>1</sup> is a branched alkyl group having 3 to 8 carbon atoms; and R<sup>2</sup> is a cyclic alkyl group having 3 to 8 carbon atoms.

**Claim 8 (Previously Presented):** A diazodisulfone compound of the formula:



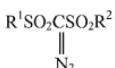
wherein R<sup>1</sup> is a cyclic alkyl group in which the alkyl group is hexyl; and R<sup>2</sup> is a cyclic alkyl group in which the alkyl group is hexyl.

**Claim 9 (Previously Presented):** A diazodisulfone compound of the formula:



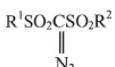
wherein R<sup>1</sup> is a branched alkyl group in which the alkyl group is butyl; and R<sup>2</sup> is a branched alkyl group in which the alkyl group is butyl.

**Claim 10 (Previously Presented):** A diazodisulfone compound of the formula:



wherein R<sup>1</sup> is cyclohexyl; and R<sup>2</sup> is cyclohexyl.

**Claim 11 (Previously Presented):** A diazodisulfone compound of the formula:



wherein R<sup>1</sup> is a branched butyl; and R<sup>2</sup> is a branched butyl.

**Claim 12 (Currently Amended):** A reduced light exposure energy photosensitive resist material comprising:

an effective amount of containing a diazodisulfone compound of formula (I):



wherein R<sup>1</sup> and R<sup>2</sup> are being independently branched or cyclic alkyl groups having 3 to 8 carbon atoms and the resist material is being used for a light source of 300 nm or less at a reduced light exposure energy amount to generate an acid to create a positive tone pattern on a surface and

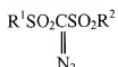
a polymer which is difficulty soluble in an alkaline developing solution but which can become alkali-soluble by the action of an acid,

wherein the effective amount of the diazodisulfone compound is sufficient for the polymer in the exposed portion to become alkali-soluble by a chemical change with the acid generated from the diazodisulfone compound by exposure energy.

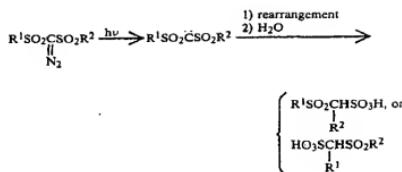
**Claim 13 (Previously Presented):** The photosensitive resist material of claim 12, wherein the light sources is selected from the group consisting of deep UV light and KrF excimer laser light (248.4 nm).

**Claim 14 (Currently Amended):** A reduced light exposure energy photosensitive resist material comprising:

an effective amount of containing a diazodisulfone compound of formula (I):



wherein R<sup>1</sup> and R<sup>2</sup> being are independently branched or cyclic alkyl groups having 3 to 8 carbon atoms and the compound of formula (I), which when exposed to KrF eximer light, generates an acid by the following reaction scheme:



and,

a polymer which is difficulty soluble in an alkaline developing solution but which can become alkali-soluble by the action of an acid,

wherein the effective amount of the diazodisulfone compound is sufficient for the polymer in the exposed portion to become alkali-soluble by a chemical change with the acid generated from the diazodisulfone compound by exposure energy.

**Claims 15 – 27: Canceled**

**Claim 28 (New):** The reduced light exposure energy photosensitive resist material of claim 12, wherein the difficulty alkali-soluble polymer is poly(p-tert-butoxystyrene-p-hydroxystyrene) resin.

**Claim 29 (New):** The reduced light exposure energy photosensitive resist material of claim 14, wherein the difficulty alkali-soluble polymer is poly(p-tert-butoxystyrene-p-hydroxystyrene) resin.

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U.S. Patent: 5,216,135

Reply to OA of **September 14, 2004**

**Claim 30 (New):** The reduced light exposure energy photosensitive resist material of claim 28, wherein the diazodisulfone compound is in an amount of 0.3g and the poly(p-tert-butoxystyrene-p-hyrdroxystyrene) resin is in an amount of 6.0g in the total material.

**Claim 31 (New):** The reduced light exposure energy photosensitive resist material of claim 29, wherein the diazodisulfone compound is in an amount of 0.3g and the poly(p-tert-butoxystyrene-p-hyrdroxystyrene) resin is in an amount of 6.0g in the total material.

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U.S. Patent: 5,216,135  
Reply to OA of September 14, 2004

**REMARKS**

Claims 7-14 and new claims 28-31 are pending in this application. Claims 1-6 were previously canceled and claims 15-27 are canceled by this amendment. Claim 7 has been allowed as indicated on p.20 of the Office Action.

The claim amendments and new claims are supported in the patent and the priority document as follows:

Claim 12: Patent: col.6, lines 15-22, 36-40 and 60-68;

Claim 14: Patent: col.6, lines 15-22, 36-40 and 60-68;

Claim 28: Patent: Application Example 1, col.13, line 19; Priority Doc.: Example 2, p.19;

Claim 29: Patent: Application Example 1, col.13, line 19; Priority Doc.: Example 2, p.19;

Claim 30: Patent: Application Example 1, col.13, lines 15-43 and col.7, lines 24-47; Priority Doc.: Reference Example 1, p.17; and

Claim 31: Patent: Application Example 1, col.13, lines 15-43 and col.7, lines 24-47; Priority Doc.: Reference Example 1, p.17.

The Applicants respectfully submit that no new matter has been added.

**Election/Restriction (Office Action p.2)**

Applicants have canceled claims 15-27 by this amendment.

**Claims 10 and 11 are objected to as being substantial duplicates of claims 8 and 9.**

(Office Action p.4)

The rejection states that when two claims are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to reject the other as being a substantial duplicate of the allowed claim. MPEP 706.03(k).

In reply to the Applicants' comments in the last Amendment, the Examiner sets forth an opinion about the description of claims 8 and 10 in the instant specification. On p.9 of the Office Action, regarding claim 10 it states:

In instant claim 10, the R<sup>1</sup> and R<sup>2</sup> variables are defined as cyclohexyl. The instant specification discloses that R<sup>1</sup> and R<sup>2</sup> can represent cyclohexyl (column 2, line 39 and line 47) and prepares a species in which both R<sup>1</sup> and R<sup>2</sup> are cyclohexyl (column 2, line 52). Therefore, claim 10 is adequately defined in the instant specification.

In contrast regarding "duplicate claim 8" on p.10 of the Office Action, it states:

It is noted that Declarant indicates that claim 8 is drawn to compounds wherein R<sup>1</sup> is cyclohexyl and R<sup>2</sup> is cyclohexyl (item 8 of Declaration filed December 20, 2002).

Applicants do not have description for the subject matter of claims 8 and 9 in the instant specification.

Again, claim 8 recites, "wherein R<sup>1</sup> is a cyclic alkyl group in which the alkyl group is hexyl; and R<sup>2</sup> is a cyclic alkyl group in which the alkyl group is hexyl," while claim 10 recites "wherein R<sup>1</sup> is cyclohexyl; and R<sup>2</sup> is cyclohexyl." If it is the Examiner's position that claim 8 is not supported because the phrase "a cyclic alkyl group in which the alkyl group is hexyl" is not *ipsis verbis* the same as cyclohexyl or that a skilled chemist would not recognize that the two descriptions are exactly the same, then the Applicants assert that the Examiner has made a mistake of law regarding the requirements of 35 USC 112, written description requirement and

a mistake of fact regarding the level of a skill of the ordinary resist chemist, much less the ordinary organic chemist.

As it has been previously explained that exact word for word support is not required by 35 USC 112 (see *In re Edwards*, 568 F.2d 1349, 1351-52, 196 USPQ 465, 467 (CCPA 1978)) and since it is admitted in the Office Action that claims 8 and 10 are essentially duplicates, the Applicants assert both claims 8 and 10 are supported in the instant specification and respectfully request to defer canceling duplicate claims pending the allowance of all claims 8-11.

**Claims 8 and 9 are rejected under 35 USC 112, first paragraph, based on the written description requirement.** (Office Action p.5)

While the Examiner cited *Fujikawa v. Wattanasin*, 93 F.3d 1559, 39 USPQ2d 1895 (Fed. Cir. 1996) for the proposition that a “laundry list disclosure of every possible moiety” is not a written description of every species in a genus, the Applicants assert that this statement is out of context here simply because it is apparent to the skilled chemist that a “laundry list disclosure of every possible moiety” is not in fact disclosed in the Applicants’ priority document.

**The disclosure in the priority document (as clearly explained on p.11-13 of the August 4, 2004 response)** is only of the limited R<sup>1</sup> and R<sup>2</sup> groups that are bulky enough so that the diazodisulfone has **low insolubility in alkali developing solution** and can generate an acid upon **reduced light exposure** according to the **reaction scheme** disclosed in **both** the priority document and the later issued US patent. The skilled organic chemist could understand this after reading the priority document. The reaction scheme is clearly explained step by step in the enclosed Declaration.

Thus the present case is more akin to *Singh v. Brake*, 317 F.3d 1334, 65 USPQ2d 1641 (Fed. Cir. 2002) for the same reasoning that reliance on *Fujikawa* here is unsound. The court in *Singh* aptly compared facts:

Singh cites *Fujikawa v. Wattanasin*, 93 F.3d 1559, 39 USPQ2d 1895 (Fed. Cir. 1996), for the proposition that an application disclosing a generic chemical formula must provide adequate direction to those of ordinary skill in the art to lead them to a subgenus of the proposed count. **We find Singh's reliance on Fujikawa to be unsound.** In *Fujikawa*, we held that disclosure of a generic quinoline structure with four variable groups, each of which could be independently chosen from a list of functional groups, provided insufficient written description support for a count directed to a subgeneric structure having a single combination of the four groups. *Id.* at 1569-71, 39 USPQ2d at 1904-05. **However, Brake 1's formula does not present the same issue as did the quinoline in Fujikawa.** First, replacing a functional group on a chemical compound can often have highly unpredictable results. We noted in *Fujikawa* that even a change as seemingly trivial as replacing an isopropyl group with the isoteric cyclopropyl group at issue in that case could result in either a significant improvement or reduction in the activity of the compound against a particular biological target. *Id.* In the present case, on the other hand, as mentioned above, there are only two subgenera that are biologically relevant; one in which a DPAP signal is present (i.e., n=1 to 4), and one in which it is not (i.e., n=0), a simpler case than in *Fujikawa*. Here moreover, claim 5 of Brake 1 discloses that "n is 0 or 1 to 4," which is a clear "blaze mark" providing in *ipsis verbis* support for n=0" in the count.

*Id.* at 1344. Here as in *Singh*, a diazodisulfone is much simpler than the complex quinoline of *Fujikawa* and thus this situation is empirically closer to *Singh* and a resulting conclusion of priority support logically follows from *Singh*.

Based on the above applicable law and the specific facts of this case, Applicants respectfully urge that claims 8 and 9 are supported by the written description in the patent and the priority document as explained on p.4 and 5 of the Response filed on February 4, 2004.

**Claims 12-14 are rejected under 35 USC 112, as being indefinite.** (Office Action p.10)

Claims 12 and 14 have been amended to address the rejection. Specifically, the claims which recite a resist material in the preamble now recites a composition comprising a compound and a polymer. The necessity of an effective amount of the compound is now recited in the claims. Specific effective amounts are recited in dependent claims 30 and 31.

A period was added to Claim 14 as kindly recommended by the Examiner.

It is believed that the amendments overcome the rejection.

**Claims 8-14 are rejected under 35 USC 102(e) as being anticipated by Pawlowski et al. (USP 5,338,641).** (Office Action p.12)

The Office Action admits on p.8, text lines 12-13, “The language found in claims 8 and 9 is found in the Japanese priority document.” Further the Office Action admits on p. 9, text line 9, “Therefore, claim 10 is adequately defined in the instant specification.” Further the Office Action states on p.4, “Claims 10 and 11 are objected to for being substantial duplicates of claims 8 and 9 respectively.” Logically having substantial duplicate claims with one defined in the specification and the language of the other found in the priority document, the claims cannot be anticipated under 102(e) because there is admitted continuous support for the claims dating back to the priority document. Therefore the rejection is moot for claims 8 and 10.

Again, the Office Action admits that there is description for claim 9 in the specification of USP 5,216,135. By the same logic as claims 8 and 10, with claims 9 and 11 being substantial

duplicates, claims 9 and 11 cannot be anticipated under 102(e) because the date of the claims precede the date of Pawlowski.

In addition, claims 8-11 are not anticipated by Pawlowski '641 for the reasons explained on p. 6-9 of the response filed on February 4, 2004.

Claims 12-14 are not anticipated by Pawlowski '641 for several reasons including the fact that claims 12-14 recite a **reduced light exposure resist material** which is used for a light source of 300nm or less. A reduced light exposure resist material is novel and **supported in the many examples in the Applicants' patent and priority document (as clearly explained on p.11-13 of the August 4, 2004 response).**

Nowhere in the prior art is there disclosed using a reduced light exposure energy as in the Applicants' patent (col.7, lines 1-12):

As mentioned above, when pattern formation is carried out by using a chemical amplified resist material containing the compound of the formula (I), a large difference in solubility in the alkali developing solution takes place between the exposed portions and the non-exposed portions. As a result, there can be formed a positive tone pattern having good contrast. **Further, as is clear from the reaction scheme (5), since the acid generated by exposure to light acts catalytically, not only the necessary amount of acid can be produced by the exposure to light, but also the light exposure energy amount can be reduced.** (emphasis added)

The novelty of a reduced light exposure material as compared to that used in Pawlowski is further explained in the Response filed on August 4, 2004.

In addition claims 12-14 recite a polymer which is difficulty soluble in an alkali developing solution but which can become alkali-soluble by the action of an acid. No where in Pawlowski '641, as will be explained below in reference to the 35 USC 103 rejection,

is such a polymer disclosed. The enclosed declaration on p.4 to 6 clarifies the empirical differences between the claimed resist material and that of Pawlowski. In brief, the resist material of Pawlowski includes a compound having at least one C-O-C or C-O-Si bond which can be cleaved by acid and a water-insoluble binder which is soluble or at least swellable in aqueous alkaline solutions. **Both the compound and binder are not in the claimed material.**

As far as new claims 28-31 which depend on claims 12-14, these claims are also not anticipated by Pawlowski'641. While homopolymers or copolymers of p-hydroxystyrene are mentioned in Pawlowski'641 (col.8, lines 63-64), poly(p-tert-butoxystyrene-p-hydroxystyrene) is not specifically mentioned, making it impossible for claims 28-31 to be anticipated.

It is therefore believed that the anticipation rejections is addressed and overcome by all claims.

**Claims 9 and 11-14 are rejected under 35 USC 103(a) as being obvious over Pawlowski et al. (USP 5,338,641). (Office Action p.13).**

Applicants respectfully urge that claims 9 and 11 are not rendered obvious by Pawlowski'641 as explained on p. 6-9 of the response filed on February 4, 2004.

Claims 12-14 are not obvious from the disclosure of Pawlowski'641 for several reasons. First, as explained in the Response filed on August 4, 2004, based on the working examples of Pawlowski'641 it would not be obvious to use a **reduced light exposure energy** with the resist material. The details of these working examples will not be explained again here.

Additionally, the reason why using a polymer which is difficultly soluble in an alkali developing solution but which can become alkali-soluble by the action of an acid is not obvious

is simply because the reaction mechanism of the claimed invention and that of Pawlowski'641 is completely different. In the case of Pawlowski'641, an additional compound having at least one C-O-C or C-O-Si bond is necessary because when such bond is cleaved by the acid generated from exposure of the diazodisulfone, the irradiated regions of the photosensitive layers become soluble in an aqueous alkaline developer. Because this additional compound is an essential ingredient in Pawlowski'641 it is logically impossible for the use of a polymer which is difficulty alkali-soluble, without more, to be obvious.

In more detail the reaction mechanism of the claimed invention is described in col.6, lines 15-22, 36-39 and 60-68 as follows:

The compound of the formula (I) is effectively used in a chemical amplified resist material wherein there is **used a polymer having a property of alkali-soluble by the action of an acid**. When the resist material is exposed to KrF excimer laser light or the like, the compound of the formula (I) present in the exposed portion generates an acid by the following reaction scheme (4): ...

When heat treatment is applied after the exposure step, functional groups of the polymer in the **resist material is subjected to a chemical change by the acid to become alkali-soluble** by the following reaction scheme (5): ...

The resulting alkali-soluble polymer is released into an alkali developing solution at the time of development.

**On the other hand, since non-exposed portions do not generate an acid, no chemical change takes place even if heat treated to produce no alkali-soluble groups.** Further, since the compound of the formula (I) has a dissolution inhibiting effect, the non-exposed portions become difficultly soluble in the alkali developing solution. (**emphasis added**)

In contrast, the reaction mechanism of Pawlowski'641 is describe in col.1, lines 12-20 and 58-63 as follows:

The present invention relates to a positive-working radiation-sensitive mixture which contains as **essential constituents**:

- a) a compound which forms a strong acid on irradiation,
- b) a **compound having at least one C--O--C or C--O--Si bond which can be cleaved by acid, and**
- c) a water-insoluble binder which is soluble or at least swellable in aqueous alkaline solutions. ....

Upon irradiation of these materials, photolysis of the compound (a) forms an acid which **brings about a cleavage of the C--O--C or C--O--Si bond of the compound (b) so that the irradiated regions of the photosensitive layers become soluble** in an aqueous alkaline developer. (**emphasis added**)

Basically, the resist material of Pawlowski'641 requires an additional compound to make the material functional. This is clear from the reaction mechanism explained on p.4 to 6 of the enclosed declaration. **The lack of this “essential” compound is logically not obvious from the reference.** It is therefore asserted that claims 12-14 are not obvious from disclosure of the reference.

Claims 28-31, dependent from claims 12-14, are also not obvious from the reference. In particular nowhere in the disclosure is the polymer and the particular effective amounts used disclosed or made obvious by any disclosure or working example in the reference.

Simply stated, the reduced light exposure resist material which is used for a light source of 300nm or less is both novel and unobvious and has been a part of the Applicants' invention since the filing of the priority document on January 30, 1990.

Based on the showing above, it is respectfully requested that all claims be allowed.

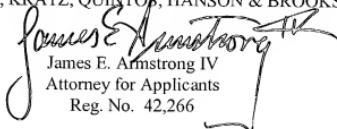
If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

U.S. Patent Reexam No. 90/004,812  
U.S. Patent: 5,216,135  
Reply to OA of September 14, 2004

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, KRATZ, QUINTOS, HANSON & BROOKS, LLP



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PATENT TRADEMARK OFFICE

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U.S. Patent No.: 5,216,135

Group Art Unit: 1626

Reexamination No.: 90/004,812

Examiner: STOCKTON, LAURA

LYNNE

Filed: October 23, 1997

P.T.O. Confirmation No.: 8528

For: DIAZODISULFONES

DECLARATION

Honorable Commissioner of Patents and Trademarks

Washington, DC 20231

Sir:

I, Fumiyoishi URANO, a Japanese citizen, residing at 4-52, Nobidome 6-chome, Niiza-shi, Japan do hereby solemnly and sincerely declare THAT:

I graduated from a master course of Shizuoka College of Pharmacy in March, 1970;

I began employment with Wako Pure Chemical Industries, Ltd., the Assignee of the above-identified application in April, 1970 and have been engaged in said company, since that time, in the study of synthesis of organic compounds and application thereof in the Tokyo Research Laboratories;

Since 1986 to 2000, I engaged in research and development of the materials for pattern formation process using KrF excimer laser and made, as one of co-inventors, many investigations in that field such as U.S. Patent Nos. 5,350,660; 5,389,491; 5,468,589; 5,498,748; 5,558,971; 5,558,976; 5,576,359; 5,627,006; 5,670,299; 5,677,112; 5,695,910; 5,780,206; 5,976,759; 6,033,826; 6,414,159; 6,586,152 and 6,723,483;

I am a co-inventor of the above-identified U.S. patent and am well aware of the prosecution history thereof;

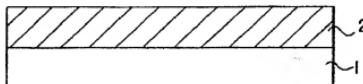
I declare the following facts with my best knowledge honestly and sincerely:

I. Resist Material of the Claimed Invention

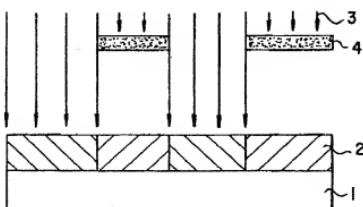
As is clear from column 6, lines 15-22, 36-40 and 60-68 in the instant specification, a resist material of the present invention contains, as main ingredients, a) a diazodisulfone compound of formula (I) as an acid generator and b) a polymer which is

difficulty soluble in an alkali developing solution but which can become alkali-soluble by the action of an acid. Therefore, a positive pattern forming process using the resist material of the present invention is illustrated as Fig. 1(a) to 1(c).

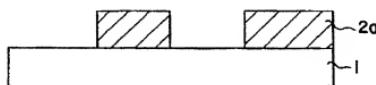
**FIG.1(a)**



**FIG.1(b)**



**FIG.1(c)**

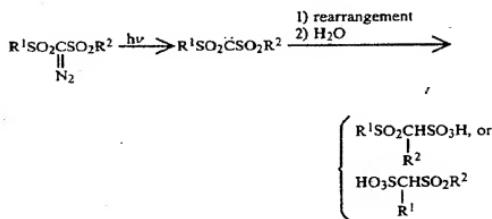


That is, the resist material film 2 spin coated on a substrate 1 such as a semiconductor (Fig. 1(a)) is exposed to, for example, KrF excimer laser light 3 of 248.4 nm selectively via a mask 4 (Fig. 1(b)), wherein, in the exposed potion of the resist material film, an acid derived from the diazodisulfone compound is generated. Then a baking (heating) step is done; thereby the polymer in the exposed potion becomes

alkali-soluble by the action of the acid. After baking, development is carried out using an alkali developing solution such as a 2.38% aqueous solution of tetramethylammonium hydroxide to remove only the exposed portions of the resist material film 2 to give positive pattern 2a (Fig. 1(c)).

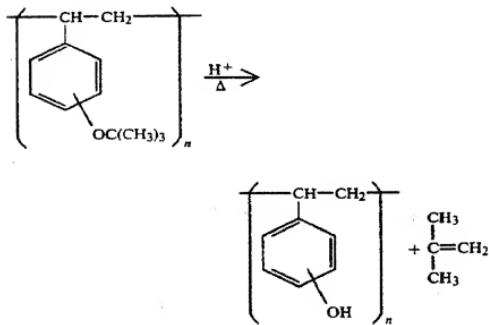
During the exposure step and the baking step, the reactions occurred in the resist material film are illustrated by the following reaction schemes.

a) Reaction scheme (1): Reaction occurred in exposure step



When the resist material is exposed to KrF excimer laser light or the like, the diazodisulfone compound of the formula (I) present in the exposed portion generates an acid by the above reaction.

b) Reaction scheme (2): Reaction occurred in baking step



When baking process is applied after the exposure step, functional groups of the polymer in the resist material film is subjected to a chemical change by the acid to become alkali-soluble by the above reaction.

As is clear from mentioned above, a positive pattern formation using the resist material of the present invention is caused that the used polymer becomes alkali-soluble by the action of an acid generated from a diazodisulfone compound.

## II. Resist Material (Positive-working radiation-sensitive mixture) of Pawlowski (U.S. Patent No. 5,338,641)

As is clear from column 1, lines 12-20, column 2, line 61 to column 3 line 18, etc. in the Pawlowski's specification, a resist material, that is, a positive-working radiation-sensitive mixture disclosed in Pawlowski contains, as main ingredients, 1) a compound which forms a strong acid on irradiation including one shown by formula (I) (hereinafter abbreviated as Pawlowski component 1), 2) a compound having at least one C-O-C or C-O-Si bond which can be cleaved by acid (hereinafter abbreviated as Pawlowski component 2) and 3) a water-insoluble binder which is soluble or at least swellable in aqueous alkaline solutions (hereinafter abbreviated as Pawlowski component 3).

Therefore, Pawlowski's resist material is different from the resist material of the present invention because Pawlowski component 2 and Pawlowski component 3 are not main ingredients in the resist material of the present invention. These compounds are necessary in Pawlowski for the creation of the resist pattern as will be explained below.

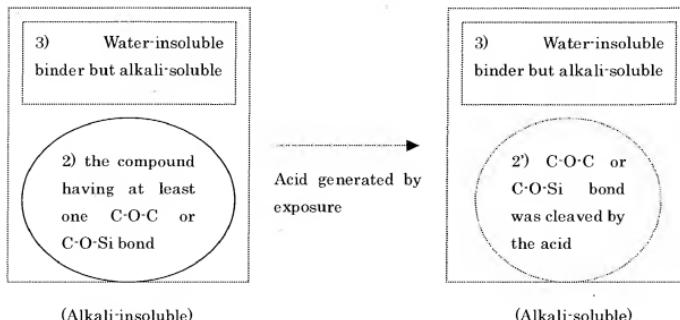
Especially, Pawlowski component 3 (i.e. a polymer as the water-insoluble binder) has a quite different property from the polymer used in the resist material of the present invention, because Pawlowski component 3 as the water-insoluble binder basically has a property of solubility or at least swellability in aqueous alkaline solutions and on the other hand the polymer used in the resist material of the present invention has a property of being hardly alkali-soluble but being able to become alkali-soluble by the action of an acid.

Furthermore, as disclosed in column 1, lines 58-63 of Pawlowski's specification, Pawlowski component 2 (i.e. the compound having at least one C-O-C or C-O-Si bond) can be cleaved by acid and as the result of the cleavage the irradiated regions of the photosensitive layers become soluble in an aqueous alkaline developer. In other words, Pawlowski component 3 has a role for inhibiting the solution of the resist material

against an aqueous alkaline developer.

Therefore, the reaction occurred in the baking step of the positive pattern forming process using Pawlowski's resist material is different from that of using the resist material of the present invention.

The reaction occurred in the baking step using Pawlowski's resist material is illustrated as follows.



That is, the resist film, which contains Pawlowski component 2 (i.e. the compound having at least one C-O-C or C-O-Si bond) and Pawlowski component 3 (i.e. the water-insoluble binder), is alkali-insoluble, because of a function of Pawlowski component 2 as an inhibitor. On the other hand, by the cleavage of C-O-C or C-O-Si bond by an acid, the resist film becomes alkali-soluble.

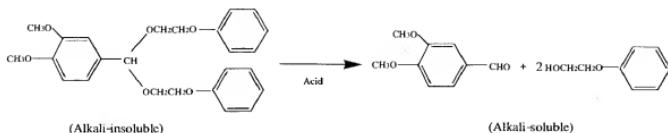
The reaction occurred in the baking step using Pawlowski's resist material is further explained in detail about Example 2 in Pawlowski (see column 12, lines 13-39 of Pawlowski's specification).

In the Example 2, bis(4-bromophenylsulfonyl)diazomethane is used as Pawlowski component 1, 3,4-dimethoxybenzaldehyde bis(phenoxyethyl)acetal is used as Pawlowski component 2, and a copolymer of styrene/p-hydroxystyrene(20/80) is used as Pawlowski component 3.

The mixture of 3,4-dimethoxybenzaldehyde bis(phenoxyethyl)acetal and a copolymer of styrene/p-hydroxystyrene(20/80) is alkali-insoluble by the function of 3,4-dimethoxybenzaldehyde bis(phenoxyethyl)acetal as an inhibitor.

In the baking step, the C-O-C bond of 3,4-dimethoxybenzaldehyde bis(phenoxyethyl)acetal is cleaved by acid generated from

bis(4-bromophenylsulfonyl)diazomethane shown by the following reaction scheme:



That is, by cleaving the C-O-C bond of 3,4-dimethoxybenzaldehyde bis(phenoxyethyl)acetal in only the exposed portions of the Pawlowski's resist material film, the exposed portions become alkali-soluble to be removed by an alkali developing solution and give positive pattern.

### III. Conclusion

The resist material of the claimed invention is chemically different from one disclosed in Pawlowski because of the presence of a compound having at least one C-O-C or C-O-Si bond and swellable binder. These are not necessary in the claimed invention because of a completely different chemical reaction mechanism as claimed in current claim 14. However, these compounds are necessary in Pawlowski for the creation of the resist pattern according to the method taught by the patent.

I, the undersigned declarant, declare further that all statements made herein of my own knowledge are true and that all statements made in information and belief are believed to be true, and; further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 7th day of December, 2004.

Fumiyoshi Urano  
Fumiyoshi URANO